Intranets

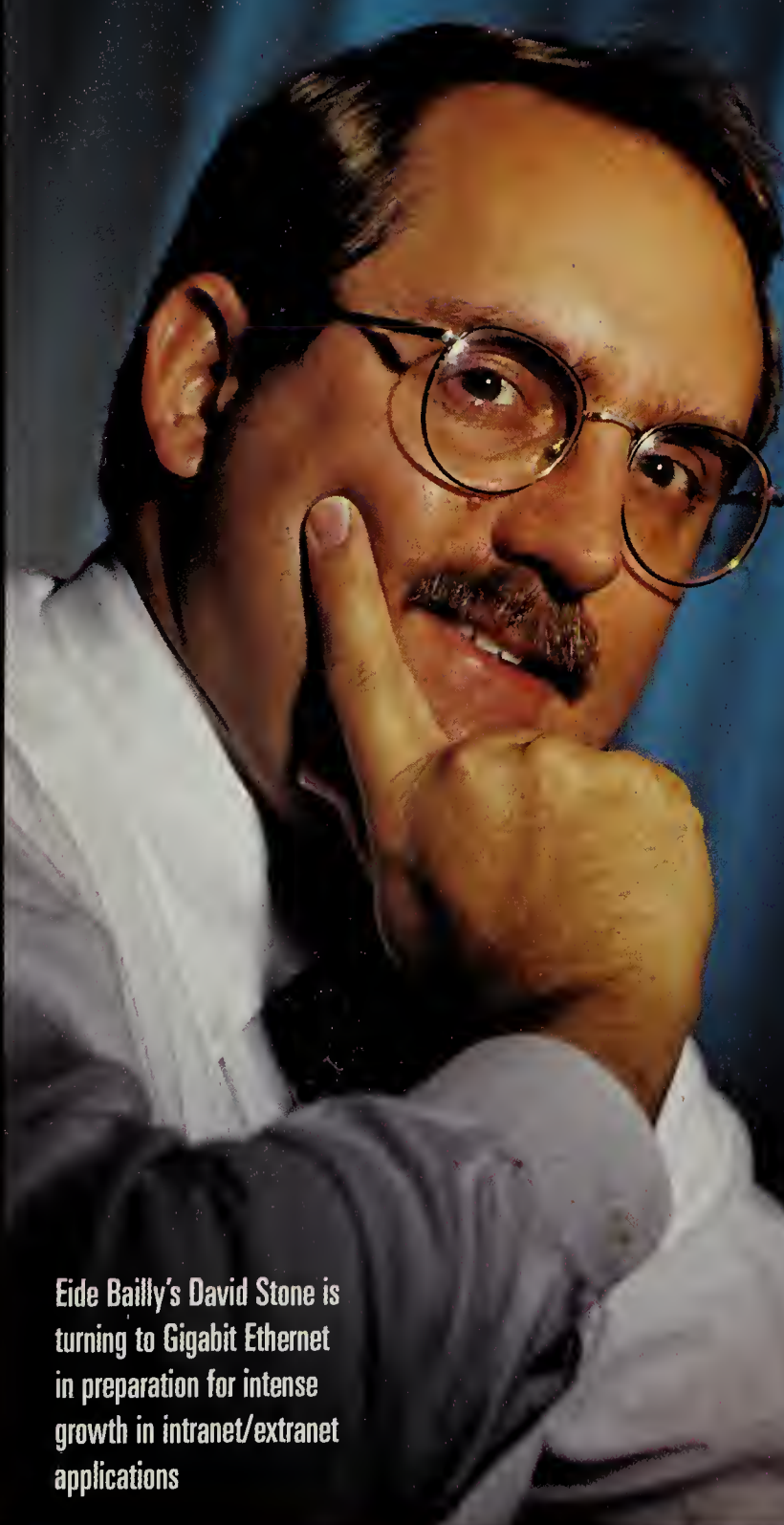**A MONTHLY LOOK AT WEB DEVELOPMENTS BEHIND THE FIREWALL**

INFRASTRUCTURE

Battling Bottlenecks, Buying Bandwidth

Corporate intranets put additional pressure on overworked networks, forcing companies to build up the infrastructure

By Tom Duffy

hen Charles Bailly and Co., a Fargo, N.D., accounting firm, merged with fellow bean counter, Eide Helmeke in May, the two companies decided to junk Eide Helmeke's 16M bit/sec. Token Ring network and instead

Eide Bailly's David Stone is turning to Gigabit Ethernet in preparation for intense growth in intranet/extranet applications

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Continued from page 1 upgrade Charles Bailly's Ethernet backbone to Gigabit Ethernet speed.

David Stone, IS manager for the combined firm, now known as Eide Bailly, was anticipating, among other things, intense growth in a number of intranet/extranet applications. The firm plans to deploy an IP-based video-conferencing application in the next two years. Other plans include developing an extranet application that would allow customers to file their debit and credit information electronically, eliminating the once classic scene in which customers show up at their accountant's office with a shoebox full of receipts.

The new network, completed in mid-June, brings 100M bit/sec. power all the way to the desktop, according to Stone. Eide Bailly employees use that power to link up to a company intranet that gives them access to policies and procedures, a document repository containing frequently used accounting forms, project schedules and a bi-weekly company newsletter.

But bottlenecks still occur sometimes at the main file-and-print server as it struggles to handle the traffic coming in through the wide open network pipes. The problem, Stone says, is that with everyone communicating with the server at such high speeds, the server can't keep up. While the delays — when they occur — last just a few seconds, it's long enough to bother Stone.

"We've created these giant roads to get to the ballpark but people can't get in because the doors are too small," he says.

As a short-term solution, Stone is in the process of installing several 100M bit/sec. Ethernet network interface cards in the server. He says he eventually plans to install a Gigabit Ethernet interface but only when he believes they have been tested enough in the marketplace to be proved reliable.
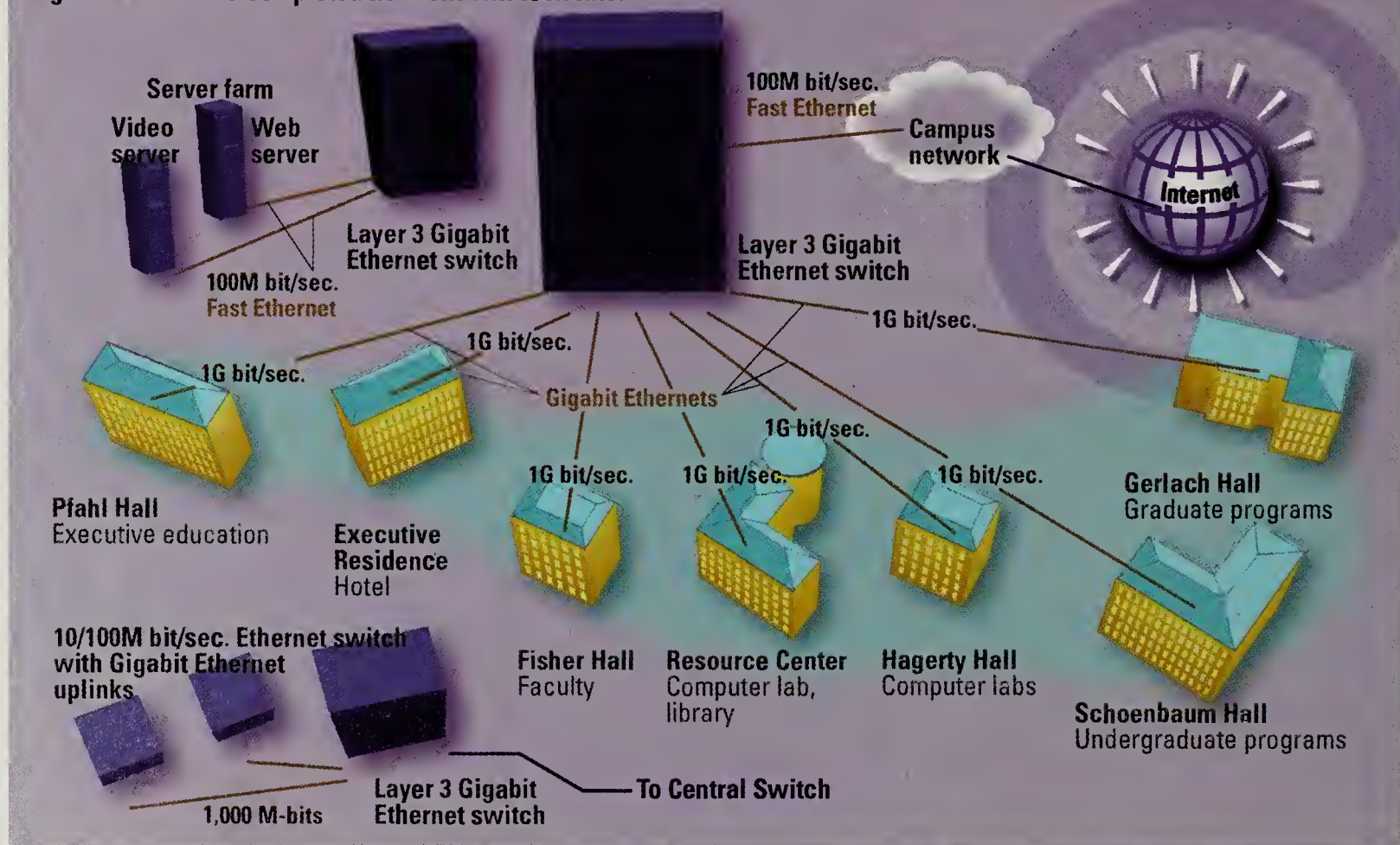
"There are a couple of cards out there, but they're not ready for prime time," he says. "I'm going to let some other people bleed on it before I put it in my server."

BANDWIDTH HOGS

At businesses around the country, network infrastructures can be described in two ways. At many firms, the bat-

It's Academic:
Ohio State University's Fisher College of Business began Phase 1 of its network upgrade from 10M bit/sec. segments to Gigabit Ethernet and high-function Layer 3 switches this summer. The college plans to upgrade to higher-density Layer 3 Gigabit Ethernet switches next summer. Fisher went with Gigabit Ethernet because of functionality, price and class of service and Layer 3 Gigabit Ethernet switches for IP multicasting and filtering, says Kurtis Lindemann, network analyst. Below is a diagram of what the completed network will look like.

Server farm
Video server
Web server
100M bit/sec. Fast Ethernet
Campus network
Internet
Layer 3 Gigabit Ethernet switch
100M bit/sec. Fast Ethernet
Layer 3 Gigabit Ethernet switch
1G bit/sec.
1G bit/sec.
1G bit/sec.
Gigabit Ethernets
1G bit/sec.
1G bit/sec.
1G bit/sec.
1G bit/sec.
1G bit/sec.
Pfahl Hall
Executive education
Executive Residence Hotel
Gerlach Hall
Graduate programs
10/100M bit/sec. Ethernet switch with Gigabit Ethernet uplinks
Fisher Hall
Faculty
Resource Center
Computer lab, library
Hagerty Hall
Computer labs
Schoenbaum Hall
Undergraduate programs
1,000 M-bits
Layer 3 Gigabit Ethernet switch
To Central Switch

teries of networking hardware and software already are under siege, nearly buckling under the weight of the demands from an ever-increasing phalanx of bandwidth-hogging intranet applications that threaten to suck up new capacity as fast as it can be added. Among the most voracious are video-streaming technologies that are in demand in industries ranging from education to financial services. And if firms are not yet struggling with how to supply bandwidth for these and other applications, they hardly can be smug. Like Eide Bailly, they know that before long they too will be in the same position.

All this comes at a time when more and more firms are seeing that state-of-the-art networks can give them a hefty advantage over their competition. Some of the advantages: better contacts with suppliers, improved customer relationships and lower costs. With the CEO paying closer attention than ever to the CIO, and the CIO tying his company's fortunes to the intranet, the stakes have never been higher.

At the same time, the challenges have never been more difficult. Rapid application development has sharply curtailed the time it takes to develop new programs, giving network managers far less time to meet the demand when new tools come online. Particularly threatening are the off-the-shelf, IP-based audio and video applications already favored by an increasing number of healthcare, government and educational organizations and now attracting the interest of financial services firms, among others.

"Most network managers realize that even if these things are not on their networks today, they are going to be soon whether they put the infrastructure in or not," says Melinda LeBaron, research director at Gartner Group, Inc. in Stamford, Conn.

Some consultants — though not LeBaron — tout buckets of bandwidth as the one-size-fits-all solution.

Tom Nolle, a networking analyst and president of CIMI Corp., a consulting firm in Voorhees, N.J., for instance, says that more and more companies are opting to over-supply bandwidth rather than tightly manage their networks. The reason, he says, is that in the past year the price of purchasing additional bandwidth from companies, such as Bay Networks, Inc. and 3Com Corp. has dropped considerably to the point where it is now about $100 per port.

"Why screw around with Layer 3 switching and Layer 2 switching when the problem is bits?" Nolle asks. "The truth of the matter is that in today's marketplace there is no reason why any user would want to adopt any strategy for LAN building other than to over-supply with bandwidth."

Perhaps, but others say that Eide Helmeke's tie-ups at the server demonstrate what Stone and other network managers already know: Complex problems rarely have simple solutions.

Solutions, however, are what network managers are looking for. For some the answer is Gigabit Ethernet, while for others it's ATM. While some firms are opting for complex management tools to carefully monitor and direct the flow of voice, data and video, others are simply widening the pipes enough to obviate the need for tight network management.

Short-term solutions include load balancing — the re-routing of network traffic around the busiest servers — and caching, which involves putting frequently requested pages in RAM on local servers.

BANDWIDTH IN ABUNDANCE

Niraj Patel, the CIO at GMAC Commercial Mortgage Corp. was worried as he watched the Horsham, Penn., firm grow from 54 employees in one

"WE WANT TO DO low maintenance and low management. We just want the network to run itself."

NIRAJ PATEL
GMAC

office in 1994 to more than 1,200 people spread out across 42 branch offices today. The firm started with a switched Ethernet network with 10M bit/sec. at the desktop scaling up to 100M bit/sec.

Earlier this year, network utilization was averaging only about 6%. Still, Patel says, customer service representatives at the loan servicing firm were experiencing delays at peak hours of a second or more as they switched from screen to screen in a commercial loan servicing application. Worse, a document imaging program from Optika Imaging Systems, Inc. took five minutes or more to create an image, a problem that was improved considerably when the proprietary client was replaced with a Web browser.

Fine-tuning network interface cards helped create some efficiencies, accord-

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ing to Patel. But he says that the addition of more and more applications, many of them intranet-based, combined with growth in the number of users simply was using up too much bandwidth. With more intranet applications on the way, the company simply stepped up to a Gigabit Ethernet backbone, dropping average utilization to about 2% (see case study Intranets, November 1997 http://www.computerworld.com/home/online9697.nsf/all/970922intra_proj).

> ## "A YEAR AGO I would have thought that ATM was going to be the de facto standard. Now Gigabit Ethernet looks like it has the potential to have much greater market-share."
>
> **BERNIE O'NEILL**
> **PRUDENTIAL**

Patel says the excess bandwidth will soon be chewed up by a variety of database-intensive, Web-based applications currently under development. Among them are a survey application that will allow the human resources department to question employees about a variety of topics and develop online reports. In the next few months, employees also will be able to track inventory, file expense reports and request loan checks through several new self-service applications under development.

With all of those applications expected to be jockeying for space on the network, he decided the best choice was simply to oversupply bandwidth.

"We want to do low maintenance and low management," Patel says. "We just want the network to run itself."

NO SUBSTITUTE FOR MANAGEMENT

But Gartner's LeBaron says that solving infrastructure problems is not nearly so simple. As Eide Bailly's Stone found out, widening the pipes can simply push the problem onto a different point on the network — for example, the I/O interface.

"The problem is that most servers can't put out a gigabit," LeBaron says. "Maybe they can put out about 400M bit/sec. So if the server becomes a bottleneck, it will throw away the traffic because it doesn't have enough processing cycles, which will just create more traffic when the original transmission has to be sent again."

In other words, management is important in any environment.

The network managers at Ohio State University's Fisher College of Business learned that lesson when they began upgrading the infrastructure from shared 10M bit/sec. segments to Gigabit Ethernet at the beginning of July. Among other things, they were facing an increase in use of WebCT, an intranet application developed at the University of British Columbia in Vancouver that allows faculty members to get course materials to students online and creates chat rooms for online office hours.

Network utilization dropped from upwards of 60% to 70% down to about 20% or so, but the problems haven't been eliminated.

"It used to be that the network was the bottleneck," says Kurtis Lindemann, a network analyst at the college. "Now the server is the bottleneck."

In the case of a trio of computer labs that previously had relied on a single Compaq Computer Corp. server, the school simply gave each lab its own Dell Computer Corp. servers. In other cases, Lindemann's team added disk arrays to several servers that are in high demand.

"You really have to architect the server to put out the bandwidth," says Lindemann. "You have to have RAID arrays or fiber channel arrays that can do a lot of intensive I/O."

When it comes to management some users have shied away from ATM because of its perceived complexity. But Gartner's LeBaron says that things have changed in the last couple of years.

"There has been a lot put in place that makes ATM simpler," she says. "There are much easier to use interfaces for configuring troubleshooting tools, for example."

At least one firm wasn't yet convinced that ATM was ready for prime time. But rather than upgrade to Gigabit Ethernet, the Prudential Insurance Company of America, Inc. has instead deferred the decision, waiting to see if one of the paradigms comes to dominate the marketplace in the next few years.

Prudential began a multimillion dollar upgrade of its corporatewide network in early 1997. On the LAN level, the firm moved from collapsed Token Ring to a switched Ethernet network with 10M bit/sec. at the desktop scaling up to a 100M bit/sec. backbone.

Among other things, Prudential was facing intense growth in intranet applications. The company built an intranet

on top of Lotus Development Corp.'s Notes that now boasts more than two dozen applications. Employees can register for training courses after viewing an online catalog of offerings, route travel vouchers and even reserve parking spaces at their site. Bernie O'Neill, vice president of distributed computing and networking for Prudential, says that the company built up the network only as much as it needed to, giving itself enough bandwidth for the present while avoiding the temptation to lock in with one technology.

"We've implanted switched Ethernet as a stepping stone," says O'Neill. "We'll either scale that to higher speed or ATM or Gigabit Ethernet. All we would have to do is take out the 100M bit/sec. Ethernet (network interface)

cards and put in cards for ATM or Gigabit Ethernet."

Which way Prudential will go, says O'Neill, depends on cost and which approach might offer the best scalability down the road.

"A year ago I would have thought that ATM was going to be the de facto standard," he says. "Now Gigabit Ethernet looks like it has the potential to have much greater market share, which means more products will be available. We're in a good position to sit back on this one until we have to make a business decision."

ATM ADVOCATE

The University of Kentucky, for one, already cast its vote for ATM and has found that the advantages far outweigh

the issues of complexity as it races to deliver video to the desktops of students and faculty to both aid in research and to supplement other course materials.

The Lexington school began building an ATM network three years ago before Gigabit Ethernet was available. Today, the school has an OC12 ATM network that it sees as the best solution to handle an ever-expanding number of video-based applications on the intranet.

"The video servers require a more mature quality of service than we can get from Gigabit Ethernet," says Doyle Friskney, associate vice president of information systems at the university. "And with ATM we could go from OC12 to OC192

Looking Beyond Hardware and Software

When it comes to making networking infrastructure choices, many network managers say that hardware and software isn't always as important as vision and consistency.

"The most important thing to do is to pick a player and stay with them," says Doyle Friskney, associate vice president of information systems at the University of Kentucky in Lexington.

"If you're going to go with Bay Networks, go with Bay for switches, routers and ATM. It's going to be tough enough to introduce quality of service. If you put a little bit of everything into the network trying to do lowest cost, you end up with the lowest common denominator," he explains.

Jim Gogan, director of networking and communications for the University of North Carolina at

Chapel Hill, says that network managers should remember that they aren't just purchasing products but rather a "technology direction" that should carry them into the future.

"We invest more in strategic direction and overall architecture than in lowest cost per port," he says. "We're not buying to address only today's concerns but also to make sure that products are developed and will be available to meet our needs two, three or four years down the road."

"THE MOST important thing to do is to pick a player and stay with them."

DOYLE FRISKNEY
UNIVERSITY OF KENTUCKY

Companies need to think very carefully about future business growth and about the types of applications they would like to put on the network when the expansion occurs, explains Jim Balderston, an industry analyst at Zona Research, Inc. in Redwood City, Calif.

"If I've got 100 people now but expect the business to triple in size, I want the network to have the capacity to do that without having to rip it out and replace it," he says. "Companies should ask: How big are we going to get? What are we going to do on the network? Are we going to do E-commerce? Are we going to tie in all of the inventory and manufacturing applications?"

The payoff, Balderston says, is great.

"The more precise a company can be in doing that, the more likely that the network, when finally built, will meet their needs."

TOM DUFFY

Isolation is not an option.

INFRASTRUCTURE

and beyond."

As far as short-term solutions go, analysts say that load balancing — managing requests and re-routing traffic around clogged servers — is among the most popular.

"Say my server in New York is getting pounded," posits Jim Balderston, an industry analyst at Zona Research, Inc. in Redwood City, Calif. "I can route customers to my server in Chicago. They may have to go further over the network and that may cause some network delays but at least they are getting some satisfaction."

Users can also load balance among local servers. That's exactly what Eide Bailly's Stone says he recently asked engineers in his department to do on a pair of servers running NetWare 4.11.

"It's a short-term solution," he says. "But we'd like to have it implemented before our next tax season coming up here."

Network managers can ease their minds about at least one topic. While the Internet backbone is slowly moving to a new standard, IP Version 6

> ## "WE'VE CREATED THESE giant roads to get to the ballpark, but people can't get in because the doors are too small."
>
> **DAVID STONE**
> **EIDE BAILLY**

(IPv6), analysts say that it's far too soon to worry about it.

"What most people want it for — the security features — have been built into v4," says Maribel Lopez, an analyst at Forrester Research, Inc. in Cambridge, Mass. "So therefore the only thing left would be addressing space, which can be taken care of with internal address-

ing or using one IP address to the outside world."

That's certainly a relief to the network managers grappling with how to create space for an ever-swelling tide of intranet applications. At Eide Bailly, those include a Microsoft SQL database currently in production that would provide a directory of specialties for every accountant in the company. There's also the back-to-the-future application that will allow customers to do online reporting of critical accounting information.

"We see a tremendous potential for using the Internet to service our clients," Stone says. "The bandwidth demands are only going to increase."

Duffy is a freelance writer based in Northampton, Mass.

PROJECT: BROCADE COMMUNICATIONS SYSTEMS

Switching Gears to Speed Simulations

By Steve Alexander

Despite its expertise in data center networking, 3-year-old Brocade Communications Systems, Inc. in San Jose, Calif., found itself no better off than nontechnology firms when it came to intranet congestion. Brocade sells high-end data center switches that are used to connect server clusters to storage arrays and enable any server to

talk to any storage unit. But that technology isn't designed for intranets. As a result, 130-employee Brocade looked to outside switching vendors to solve the intranet transmission speed bottlenecks that were slowing Brocade's new product development, which relied on running large software simulations over the intranet. An initial hardware upgrade was made a year ago, and by year's end Brocade hopes to further improve performance by consolidating many switches into a few switch chassis'. Josh Judd, Brocade network engi-

neer, explains what had to be done.

WHAT THEY'RE DOING
Our pattern of intranet use required higher speed because we have machines running simulations and compiles to network file servers as part of new product development. If the connection to the file servers is slow, that is a bottleneck in product development. So obviously it is in our best interest to make that fast. We looked to outside vendors because the intranet upgrade required different technology than we sell.

WHY THEY'RE DOING IT

Our intranet is scaled for current requirements, but there is not much breathing room. Today our intranet uses a mixture of Gigabit Ethernet and 100M bit/sec. and 10M bit/sec. Ethernet, all switched.

If we did nothing to improve the intranet, we couldn't add many more switches to the switch array we already have because there are physical limitations on the number of ports available. In addition, as you add switches to this kind of array it gets exponentially harder to manage in terms of configuration changes, troubleshooting and other management tasks. A switch chassis was definitely the way for us to go from a management standpoint.

But at the time we purchased this equipment a year ago, we couldn't get it in chassis form. As a result, we have 27 workgroup switches (FastIron Workgroup Switches) and six backbone switches (FastIron Backbone Switches) from Foundry Networks, Inc. in Sunnyvale, Calif., all interconnected with Gigabit Ethernet. Working with Foundry, we'd like to reduce that system to a couple of chassis'.

The advantage on a chassis is that it has a lot of ports, so most things that need to talk to each other fast can be on the "A" chassis. You can put slower things on the "B" and "C" chassis', which, by trunking together several one gigabit lines, can be linked to the "A" chassis with eight gigabits of bandwidth. We need about 500 workstations, compute servers, disks and printers, so we probably will end up with three chassis' in December or January.

HOW THEY'RE DOING IT

We're doing it in stages. A year ago we had shared 10M bit/sec. hubs chained together using 10M bit/sec. Ethernet switches. To improve that speed, we did a major upgrade about a year ago by adding the Foundry switches and faster Ethernet. Later this year we'll do the upgrade to the chassis, not to improve speed but to improve manageability.

BENEFITS

Besides giving us better bandwidth, the next upgrade will improve intranet man-

BROCADE'S JOSH JUDD: A switch chassis was definitely the way for us to go from a management standpoint

agement. Now, any time we want to make a configuration change, the change has to be made on 33 different switches. By consolidating those switches into chassis', we might have to change two or three switches. In addition, it will be easier to do troubleshooting.

TECHNICAL CHALLENGES

We've already familiarized ourselves with all Foundry Networks configuration options and commands, so this upgrade should be pretty much a slam dunk.

We didn't look at ATM because it's slower and more difficult to set up, and it would have required replacing a whole lot of host adapters because ATM won't plug into an Ethernet port. If we stuck with Ethernet, we would not have to change anything.

COSTS

A year ago the upgrade cost us $250,000. This year's upgrade was thrown in as part of that because we are beta testing Foundry Networks' equipment.
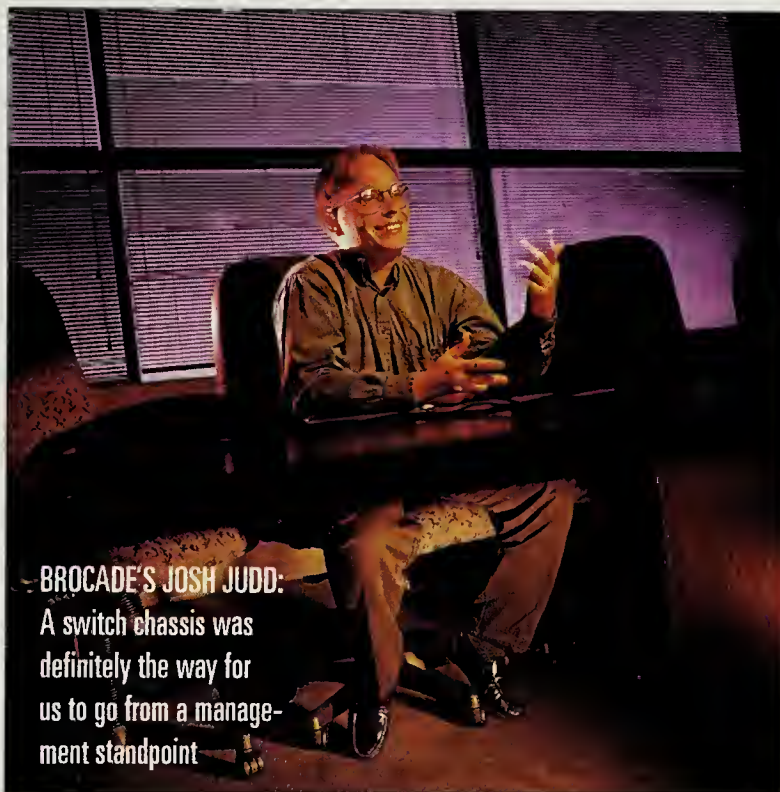
RETURN ON INVESTMENT

We don't waste time on it. If I go to the engineers and ask, "Are the simulations running faster?" they say, "Way faster." And that is enough of a quantification. All of our management and engineers are network people, so they know what "way faster" means.

ADVICE TO OTHERS

Be really sure you know what you want to get out of a network upgrade before you do it. Do you want faster network connections, ease of management or cost savings? The big plus on Foundry is that all the stuff that comes up often is really easy to do. The hard parts with Foundry are configuration changes and troubleshooting, things that don't come up often. But you have to know what you're trading off.

Alexander is a freelance writer based in Edina, Minn.